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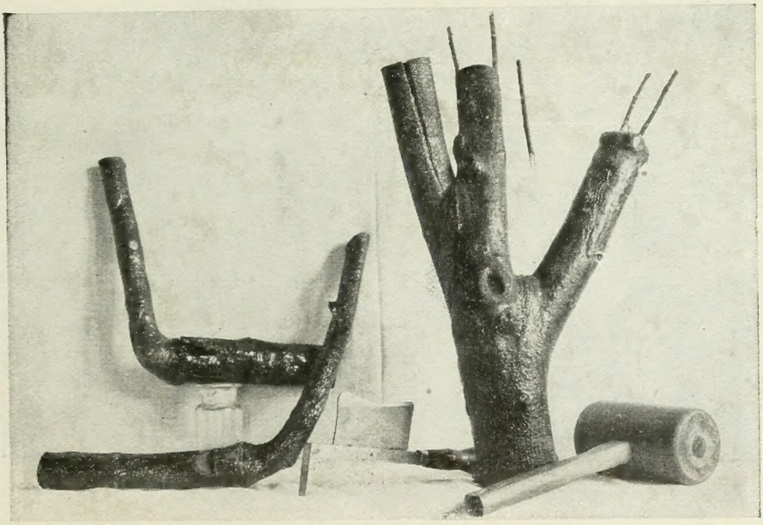
Propagation of Plants

By VERNON H. DAVIS,

Assistant Professor of Horticulture.



1 3 4 5

2

CLEFT GRAFT

1. An imperfect union, one cion has died and decay is beginning. 2. A perfect union, showing no traces of decay. 3. Grafting chisel. 4. Left stock, prepared and split; middle stock with cions set; right stock waxed, graft completed. 5. Grafting mallet.

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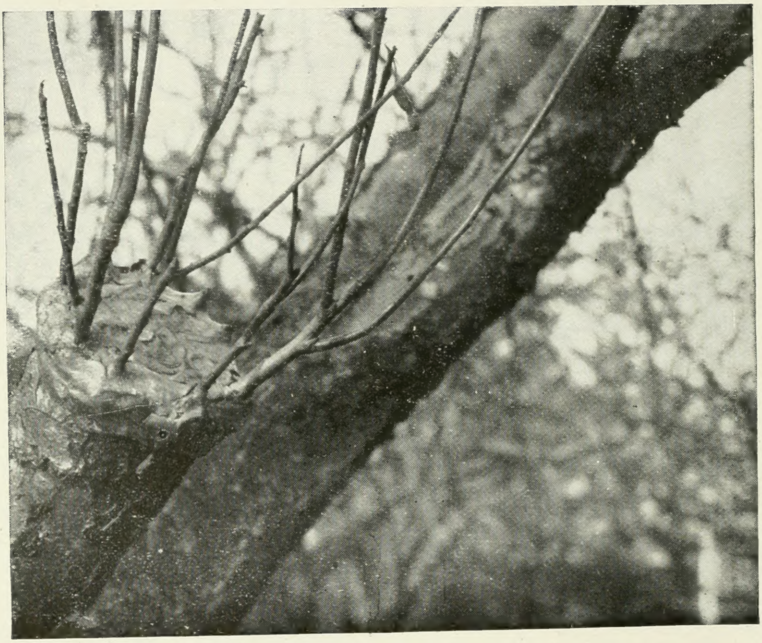


BARK GRAFT, ONE YEAR OLD
All the cions grew except two.

Propagation of Plants

By Vernon H. Davis.

Plants are propagated or reproduced by numerous methods, all of which may be classed under two distinct headings: First, by seeds or spores; second, by the vegetative method, or "division of the plant."

Seeds are the results of the sexual union of two individual plants, and the resulting plant cannot be considered as strictly a part of either of the parents, and does not necessarily resemble either. Seeds are commonly used in the reproduction of annual and biennial plants, especially where the exact parental form is not absolutely essential, as in the cereals, forest trees, seedlings for grafting and budding, etc. Seeds are most commonly used with the ordinary farm crops and with many garden crops. This method of propagation is well understood.

Division is used with plants that produce seeds sparingly or not at all, as the horseradish, banana, seedless orange, apple, etc. Some plants are more easily and cheaply propagated by division, and this is the method always used when the exact parental form is desired in the offspring, as in our fruits and many ornamental trees, shrubs and flowers. The new plant resulting from any of the methods of division may be regarded simply as a continuation of the growth of the parent under new surroundings and with few exceptions resembles it very closely. Modern horticulture is very largely dependent upon the reproduction of exact parental forms by various methods of division, the most important of which we will attempt to describe briefly.

The various processes may be likened to surgical operations. While plants are less sensitive than animals, they are, nevertheless, living organisms. Violent operations, when necessary, should be performed with this fact in mind. A good sharp instrument that will make a clean, smooth cut should always be used, and needless injury and careless handling avoided. The presence of at least one healthy bud in the part taken for propagation will always be found helpful and is usually essential.

Since the law requires that Agriculture be taught in the common schools during the coming year, it has been thought best to republish some of the Extension Bulletins which will be most helpful in conducting the work.

The College of Agriculture will help teachers and others to name plants, insects, fruits, etc., from specimens mailed or expressed. Our desire is to see Nature Work and Agriculture successfully pursued.

A. B. GRAHAM,
Superintendent of Agricultural Extension.

The methods of propagation by division naturally divide themselves into two classes. First, those in which the part selected for reproduction remains a part of the parent plant until roots and leaves are formed, or until the new plant becomes self-supporting. These are the simplest and easiest methods and are very largely employed. In the methods of the second class the parts to be used are, in the beginning, cut away from the parents and placed under conditions which favor the formation of the parts necessary to make the new plant self-supporting or which favor its union with a part of some other plant.

DIVISION OF THE CROWN

Many plants develop a large number of buds or growing points on their roots and root stalks, which are often taken up and divided into as many pieces as there are eyes or buds, each part being treated as an independent plant. Familiar examples of such division may be seen in the common methods of multiplying rhubarb, asparagus, cannas, and many other perennial herbaceous plants.

SUCKERS

Suckers are shoots that grow upward from the roots or underground stems, and form young plants around the parent. The shoot, together with a piece of the root or stem from which it grows, is dug up and removed to a new location. The red raspberry and blackberry are propagated from suckers. Some varieties of the cherry and plum are also multiplied to a limited extent by this method. The propagation of woody plants in this way usually results in an increased tendency to form suckers which often become seriously troublesome in cultivation. The production of suckers will be stimulated by any cutting of the roots or a severe top pruning. Sucker plants have a poor root system and for the first few years make an unsatisfactory growth.

LAYERING

Layering is the multiplication of plants from the low-lying shoots and runners that naturally come in contact with the soil and take root at the nodes or joints; or from upright branches that are bent down to the ground and covered with the soil. Layering is one of the simplest methods of propagation, since the parent nurses the layer-plants until they can sustain themselves; it is a reliable and ready means of reproducing many hard-wooded plants that do not readily strike root from cuttings. The black raspberry and dewberry are familiar examples of plants propagated from natural layers. The tips of the branches strike the ground, and if the soil is loose and mellow, they take root readily.

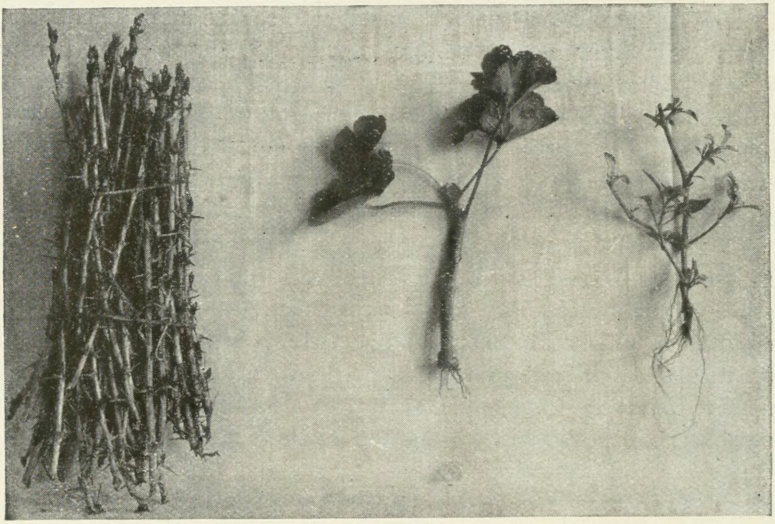
The parent branch is cut off from 4 to 6 inches above the ground and a separate plant known as a "root tip" is secured. The short portion of the old branch serves as a handle in carrying the plant. In most cases of layering the branches must be bent down and covered with soil. This covering may be continuous for a considerable distance along the stem, or the joints only may be covered. The covering should not be more than 2 to 5 inches deep. If more than one is grown from a shoot, the plants will usually lack in uniformity and vigor. Hard-wooded plants do not strike root readily from layers; to induce the formation of roots, the branch is twisted, girdled, or split at the point where it is desired that they be formed. In commercial propagation, the parent plants are often cut back to the ground in order to secure many shoots fit for layering. The new shoots of the gooseberry, quince, and paradise apple are not bent down to the ground, but the soil is heaped up around their base in the shape of a mound. The shoots send out roots near this base, producing straight, stocky plants, which may be set out in their permanent location after one year in the mound, or may be taken off and grown another year in the nursery row.

Pot or aerial layering is confined almost entirely to the greenhouse, where uniform moisture and heat can be maintained. The stem is split or girdled at the point where roots are desired, and surrounded by moss or soil to retain the moisture. Roots start from the injured parts; when they fill the material placed around the stem, the branch is cut just below the layer and treated as a separate plant. The common house rubber-plant is propagated in this manner.

CUTTINGS

A cutting is a part removed from the parent plant and placed under conditions favorable to growth. It may be either a leaf or stem of active, growing tissue, or a stem or root of inactive, dormant tissue. In either case, the cutting should be of healthy material; it should contain prepared food (starch, proteids, and oils), or tissue capable of preparing plant food; and it should contain one or more buds or growing points.

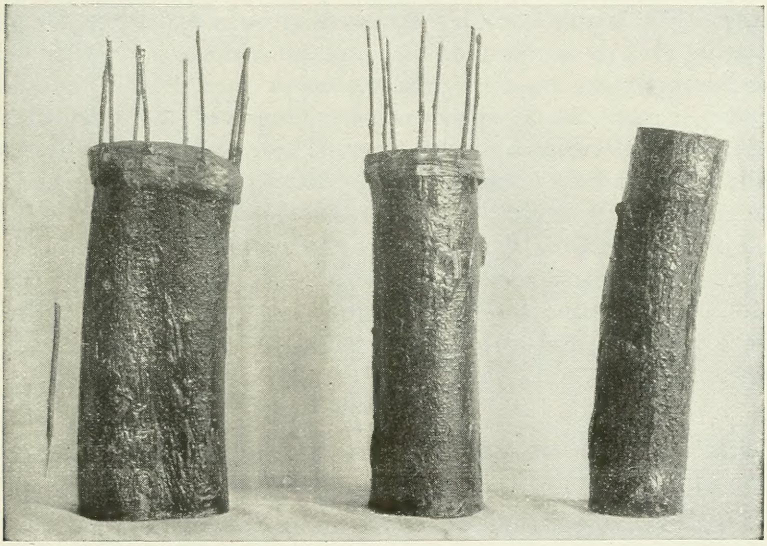
All cuttings require a moist, warm atmosphere and a porous soil, which, in some cases, must be warmer than the air above it. The degree of heat and the amount of moisture necessary to induce root formation from cuttings vary greatly for different plants. Many hard-wood dormant cuttings will grow readily out of doors, but cuttings of most plants strike root better if the air can be kept cool and the soil warm, with plenty of moisture in both until the roots form. For starting cuttings of many of the common flowers and ornamental plants, a shallow earthen vessel filled with sand, placed in the living room and kept moist will answer. The common manure hotbed will serve in starting most plants, both from seeds and cuttings. This is made by digging a pit 18 to 24 inches deep in a location well-protected and well-drained. The pit is filled with fresh horse manure that has been thoroughly forked over and has started to heat. In filling the hotbed, the manure should be solidly packed or tramped. A bottomless frame or box with one side higher than the other is then set over the pit with the low side toward the south. From 4 to 6 inches of sand or sandy loam is placed over the manure. After the heat has fallen to 90 degrees F. the seed or cutting may be placed in the soil. The frame is covered with a glazed window sash.



CUTTINGS
1 Hardwood cuttings, Gooseberry. 2 Geranium—softwood cutting.
3 Alternathea.

In propagation from green cuttings, healthy, vigorous, young shoots from 1 to 3 inches in length are taken. The leaf surface is reduced by removing some of the leaves, entirely or in part, to lessen the loss of moisture from the part before roots have formed to absorb nourishment from the soil. The large end of the cutting or the end that grew nearest the body of the parent plant should be placed at a depth of from 1 to 2 inches in the soil. The cut should be made at, or near, a node or joint, because roots form more freely at this point. As soon as rooted, the cuttings should be transferred to a rich soil from which plenty of plant food can be secured. Geraniums, carnations, chrysanthemums, roses, and many other plants are propagated from the growing stems.

The begonia and some other plants having thick, fleshy leaves with large veins or nerves are frequently propagated by leaf cuttings. After being cut across the principal veins in several places, the whole leaf may be pegged or weighted down to the sand in the cutting bed and new plants will spring from the wounded points. The leaf may be split along the mid-rib and the cut edges placed in the soil, or it may be cut into triangular pieces with the point extending into the mid-rib and placed in the soil point downward.



BARK GRAFT
1 Stock. 2 Cions set and tied.
3 Waxed, graft completed. Cion on the left.

The currant, gooseberry, grape, and lilac are readily propagated from hard-wood cuttings. These should be taken in late fall or early winter, tied into bundles of convenient size, and stored in a cool, moist cellar or buried in the soil below the frost line. They should be from 6 to 10 inches in length. In the springtime they may be placed in the greenhouse, the hotbed, or out of doors in a rich, loose soil. It is usually best to rub off the buds with the exception of one or two at the top, otherwise more than one stem may be secured. This is especially true of shrubby plants, such as the currant and gooseberry. The cuttings should be placed upright or slanting in the soil and only one or two buds be allowed to show above ground.

Certain plants are frequently propagated by root cuttings, which should be about the size of a lead pencil. These are taken in the fall after growth ceases, cut up into pieces from 1 to 3 inches long, and packed in boxes with alternate layers of moist sand. The boxes are stored in a cool, moist cellar until spring, when the roots are placed in the propagating bed or sometimes in a well-prepared soil out of doors in furrows about 1 to 2 inches deep. Both roots and leaves start from these small pieces. The blackberry is often propagated in this way.

Although tubers are simply thickened roots or stems, tuber cuttings are so unlike ordinary stem or root cuttings that they deserve special mention. The most common tubers are the Irish and the sweet potatoes. The Irish potato contains eyes or buds and is cut for planting so that each piece will contain one or more of these growing points. Roots rarely spring from the tubers themselves, but from the base of the new shoots. These shoots may be removed and transplanted, and new ones will arise from the tuber. Three or four crops of sprouts may be obtained from the same tuber. This is the common method used in propagating the sweet potato. The tubers are placed in the hotbed whole or are cut once the long way and placed in the soil with the flat side down. Shoots arise from the skin of the tuber at almost any point. Cuttings from the stems of tuber-producing plants will often produce tubers instead of roots. These tubers must then be planted to secure a new plant.

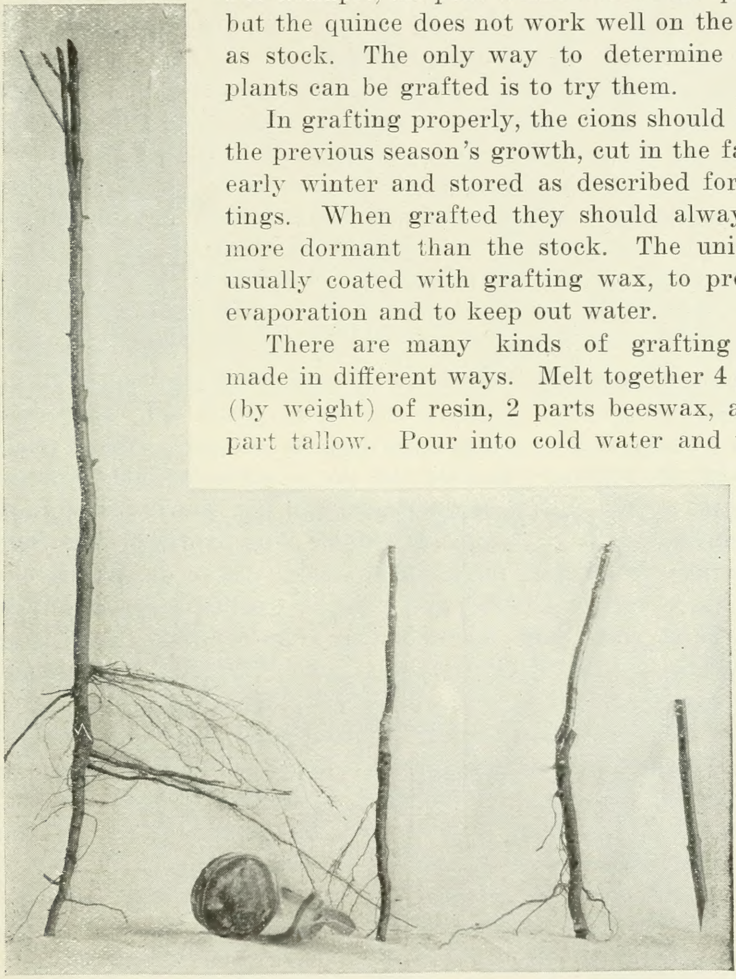
GRAFTING

Grafting is one of the most interesting methods of propagation. All the named varieties of fruit and many ornamental trees and shrubs are perpetuated by grafting. This process is the placing together of two portions of the same or different plants in such a way that the parts will unite and continue to grow as if the two parts had never been separated. This union takes place most rapidly when growth is most rapid, usually in early springtime. The plant to be changed is called the stock; the part to be united to it is called the cion. Stock and cion, with few exceptions, retain their individual characteristics. Thus we may place cions of the Yellow Transparent, Baldwin, and Tolman Sweet apples on a Northern Spy tree and secure sweet and sour, white and red, summer and winter apples, all from the same tree and all nourished by sap passed through the Northern Spy stem.

Not all plants can be grafted, but different varieties of the same kind will generally unite readily; for example, the Jonathan and the Grimes Golden apple, the Elberta and the Smock peach. Different species often unite, but not as readily as do varieties; for example, the peach and plum, pear and quince, potato and tomato. Plants as unlike as the oak and chestnut, pear and thorn, or pear and mountain ash, will sometimes unite, but such a union is very rare. Many plants that unite freely in one direction fail to unite when worked in the other. For example, the pear works well on the quince, but the quince does not work well on the pear as stock. The only way to determine what plants can be grafted is to try them.

In grafting properly, the cions should be of the previous season's growth, cut in the fall or early winter and stored as described for cuttings. When grafted they should always be more dormant than the stock. The union is usually coated with grafting wax, to prevent evaporation and to keep out water.

There are many kinds of grafting wax made in different ways. Melt together 4 parts (by weight) of resin, 2 parts beeswax, and I part tallow. Pour into cold water and when sufficiently cool work with the hands, as one does with taffy, until the mass turns a buff color. Make into rolls and wrap in waxed paper.



WHIP GRAFT

1. Cion showing sloping cut. 2. Stock and cion placed together. 3. Wound wrapped with grafting tape. 4. Ball of grafting tape. 5. One-year-old apple tree showing perfect union of stock and cion. Notice the roots that have come out from the cion above the graft.

Irregular white line indicates where cion and stock have grown together.

Grafting cord is made by soaking balls of common yarn in the hot wax for five or ten minutes.

METHODS OF GRAFTING

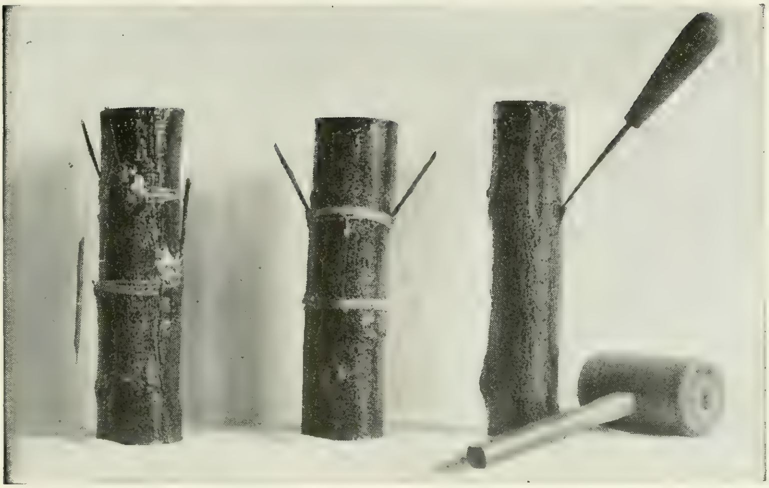
Of the numerous methods of grafting that are practiced only a few of the most important will be described.

The whip graft is used only when both the stock and cion are about the size of a lead pencil or a little larger. Both are prepared with a sloping cut about an inch long. A vertical cleft or split is made in each cut end near the center, and the two are joined by pushing the tongue of one into the split of the other with considerable force. If the sharp points slip past the cut, they should be trimmed off and the joint wrapped tightly with grafting cord or tape. (See method of making wax.) The whip graft is frequently used in top working plants while young and small, but it is most commonly performed indoors in the winter time upon the roots of apple and other common fruits. The apple stocks are small seedlings one or two years old. These are dug in the autumn and stored as described for cuttings. When ready for grafting, the roots are washed and the larger side roots trimmed off. The stem is then cut off at the crown and the root is prepared as described above. It is frequently cut off 2 or 3 inches down and the remaining root shaped for another stock. Three or four stocks are often made from a single root; these are called piece-rooted grafts. Many nurserymen make a single stock from one root, which is known as a whole-root graft. Other things being equal, the whole-root grafts will generally give the best root systems and the most vigorous plants.

The root-grafts should be tied in bundles and stored as cuttings are, until the following spring, when they should be set out in a rich soil, deep enough to cover the point of union. (See cut on page 9.) Sometimes roots develop from the base of the cion as well as from the stock, and the tree is then said to be ''own rooted.'' This result is often advantageous, especially if the cion is from a very hardy plant.

Cleft grafting is used chiefly in changing the tops of trees to another variety. The stocks are considerably larger than the cions. They are sawed off with a sharp saw and the stub split across its center with a grafting chisel. (See cut on cover page.) The large end of the cion is cut wedge-shaped and a litte thicker on one side than the other and is so placed in the split that the growing cells come in contact with those of the stock. The cion is slanted slightly outward.

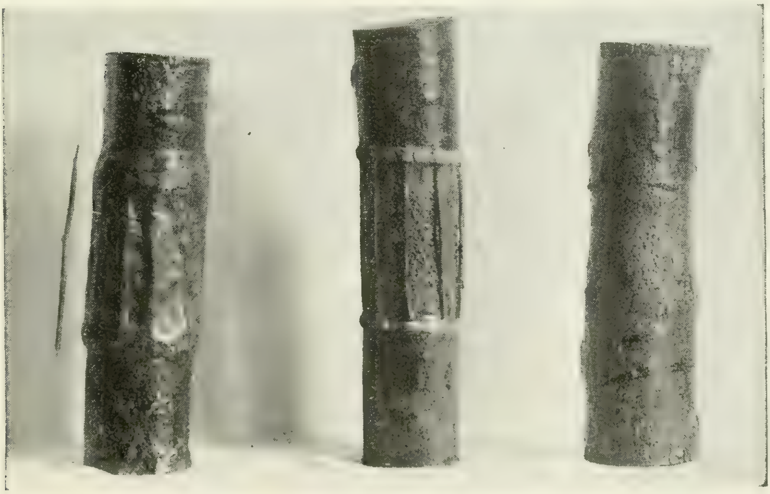
The pressure of the stock will usually be sufficient to hold the cions in place. If the stock is an inch or more in thickness, two cions should be inserted, one on each side. The cion should be from 3 to 6



SIDE GRAFT

1. Stock, chisel and mallet. 2. Incision made, cions set and wrapped. 3. Waxed, graft completed. A cion on the left.

In this and in other pictures of grafting, a prepared cion is attached to the side of the stock simply to show how it is made.



BRIDGE GRAFT

1. An injured trunk. 2. Wound dressed, cions inserted and tied. 3. Waxed, graft complete.

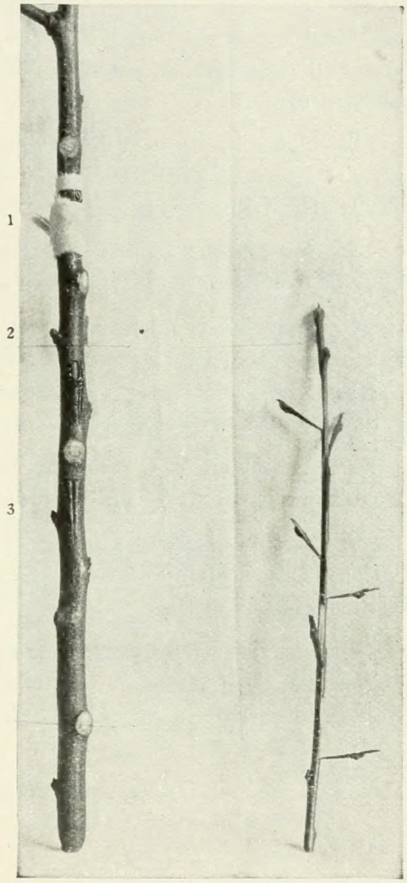
inches in length and cut in such a way that a bud on its thicker edge will come just flush with the top of the stock. The wedge-shaped cut should be about one inch in length and after the cion is inserted all the exposed, wounded surface should be covered with grafting wax. Branches larger than three inches in diameter should not be grafted by this method.

The side graft is a method adapted to medium-sized stocks. The incision is made by driving a narrow, thin-bladed chisel obliquely into the side of the stock to the depth of about one inch. The cion is cut wedge-shaped and is pressed into the incision until its cut surfaces are covered. The wound is then tied and covered with wax. The top of the stock should be cut back severely in order that a part of the energy of the plant may be directed into the cion. The wound made is small and more than one cion can be set in the same stock, thus increasing the chances of securing a union. If none of the cions grow, the wounds heal readily and the tree or stock is still intact. (See cut on page 11.)

Bridge Graft.—This method is often resorted to to save the life of trees that have been injured by mice, rabbits or other enemies. The wound should first be dressed, by cutting the ragged edges of bark back to solid tissue, and then painted with lead paint. Rather slender cions should be selected and cut thinly wedge shaped at both ends and from 1½ to 2 inches longer than the width of the wound. Slip the knife-blade between the bark and wood on one side of the wound. One end of the cion should be started under the bark and pushed down firmly, then the cion should be sprung out and the other end started under the bark on the other side in the same way. The cion should extend about ¾ to 1 inch under the bark on each side, the bark tied tightly over the cion; and the whole wound, cions and all, covered with wax. The cions should be set around the stem as closely as possible. Any growth which starts from them should be rubbed off. These cions are to serve as a bridge over which the plant food may be carried.

Budding is a kind of grafting where a bud only is taken, with very little wood, and used as a cion. It is placed under the bark of the stock, where the union takes place. The work is usually done in the late summer or early fall, but in some cases may be done in the spring. It must be done when the bark slips easily. There is but one style of budding in common use in this country. This is known as shield or "T" budding, from the shield-like shape of the piece of the bark taken off with the bud, or from the shape of the cut in the stock, which is that of the letter T.

The minor details will differ with every operator and with the kind of plant. In common practice in the North, budding is performed from early July to September. The stocks should be about three-eighths inches in diameter at the point where the bud is to be set. The buds are taken from strong shoots of the current season's growth, cut the day they are to be used, trimmed at once and rolled in moist cloth or paper until used. The buds are cut with a thin-bladed knife. The part taken should be about one inch long, with the bud just a little above the middle and a small sliver of wood just underneath it. The wound to receive the bud is made by a vertical and a transverse cut through the bark. The points of the bark are then loosened and the bud started just underneath them and pushed downward until the entire bud has passed into the cleft. The bark is then bound down tightly over the bud, with raphia fiber, strips of cloth, or string. The bud will set or fasten itself in two or three weeks, when the bandage should be removed by drawing a sharp knife through the string just back of the bud. The bud should remain perfectly dormant until the following spring, when the stock should be cut off just above it, so that all the energy of the root system may be thrown into this single bud. The bud should be set just as close to the ground as possible, usually from 3 to 5 inches, so that the crooked place left may be covered up when the tree is transplanted to the orchard.



a. BUDDING a.

a. Peach stock. 1. Incision made and bark lifted to receive the bud. 2. Buds inserted. 3. Buds wrapped. b. Bud stick with buds cut.

PROBLEMS

1. Suppose two fields of potatoes of an acre each are owned by different farmers. One farmer sprays to cure the blight and gets 188 bushels of potatoes worth 25 cents per bushel. The other neglects his field and gets but 75 bushels. What is the difference in the value of the two crops?

2. A man owns a flock of sixty hens. He receives as an average for each hen, per year, 80 eggs. When eggs are worth 25 cents a dozen, what is the value of the eggs?

3. How many bushels of corn at 45 cents a bushel will the money received for the eggs buy? Oats at 35 cents?

4. Suppose it takes only twelve bushels of corn, 5 bushels of oats, and $8 worth of other food to keep this flock for one year, in addition to what they pick up for themselves. What is the profit over and above the cost of the feed?

5. What will it cost to dig an open ditch on each side of a slough 10 rods wide and 100 rods long at $0.25 per rod?

6. A cow requires about 4 ft. by 9 ft. floor space for a stall, with 4 ft. by 3 ft. additional for a manger. How much floor space will be required for 20 cows?

7. If a cow eats 3 tons of hay worth $6 per ton, 1000 lbs. of ground feed worth 80 cents per cwt., and pasture amounting to $5 in a year, what does it cost a farmer to keep a cow? Will a ''scrub'' cow cost as much?

8. A ''scrub'' cow will give 15 lbs. of milk, worth 80 cents per cwt., daily for 300 days in the year, and raise a calf worth $3.00. What is the farmer's profit on her?

9. A Jersey cow will give 25 lbs. of milk daily for the same time and raise a calf worth $5. What is the farmer's profit on her?

10. How much more does he make on the Jersey than on the ''scrub?''

11. One of the many kinds of grafting wax is made by melting together 4 parts (by weight) of resin, 2 parts beeswax, and 1 part tallow. What per cent. of the whole is each ingredient?

NOTE: The first ten problems are taken from Hatch and Haselwood's ''Elementary Agriculture.''

Announcement.

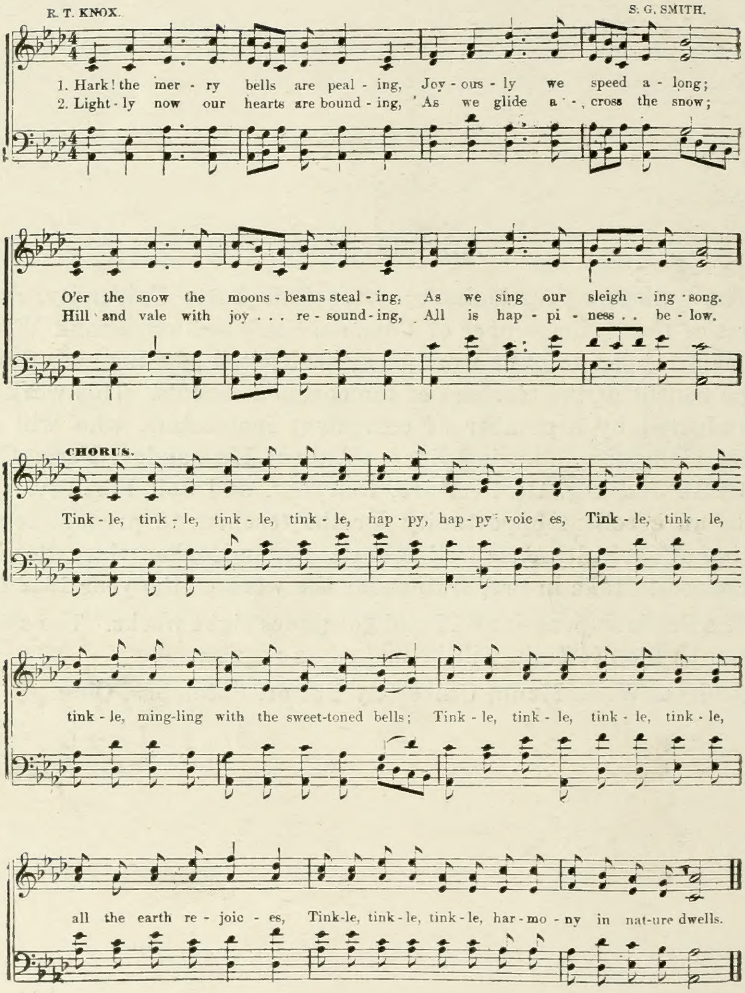
The College of Agriculture of the Ohio State University, at the request of the Commissioner of Common Schools, Hon. Frank W. Miller, has arranged to offer work in agriculture in the Summer Session for the benefit of the teachers of the common schools. This work will be conducted by a number of competent instructors, who will give courses along the following lines: Animal Husbandry, Farm Crops and Grain Judging, Horticulture, Dairying, and Soil Fertility. This will be an excellent opportunity for the teachers to prepare for the teaching of agriculture, as well as for the examination which they will be required to take in preparation for the work of the year 1912-13.

The Session opens June 17 and continues eight weeks. The special Summer Session bulletin will be mailed on request.

Address W. E. Mann, University Editor, Columbus, Ohio.

Sleighing Song.

R. T. KNOX. S. G. SMITH.


1. Hark! the mer - ry bells are peal - ing, Joy - ous - ly we speed a - long;
2. Light - ly now our hearts are bound - ing, As we glide a - cross the snow;
O'er the snow the moons - beams steal - ing, As we sing our sleigh - ing song.
Hill and vale with joy . . . re - sound - ing, All is hap - pi - ness . . be - low.
CHORUS.
Tink - le, tink - le, tink - le, tink - le, hap - py, hap - py voic - es, Tink - le, tink - le,
tink - le, ming-ling with the sweet-toned bells; Tink - le, tink - le, tink - le, tink - le,
all the earth re - joic - es, Tink-le, tink - le, tink - le, har - mo - ny in nat-ure dwells.